

# 9 Dynamics of populations

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## INTRODUCTION

Why are fishes more abundant in some areas than others? Why do abundances vary over time? What factors limit the sizes and productivity of populations? How do natural populations respond to harvesting, and where do we draw the line between sustainable and unsustainable fisheries? These are some of the questions that motivate researchers, and they underpin important issues in conservation and management. The answers might easily command a book but our focus, of course, is freshwater fishes and fisheries in Australia.

The size of a population is determined by interplay between the environment and four processes, namely recruitment, mortality, immigration and emigration. To understand how these interact, we need information about movements (Ch. 5), trophic dynamics (Ch. 6), life histories and recruitment (Ch. 7), age and growth (Ch. 8) and the influence of invasive species (Ch. 11). Here, we draw on these topics to illustrate the dynamic changes that occur in patterns of abundance, recruitment, mortality, migration, growth and production. We introduce some concepts, then consider population models and the impacts of fishing.

## BASIC CONCEPTS

While the biology of some Australian freshwater fishes is reasonably well-known (e.g. Australian bass, *Perca-  
lates novemaculeata*; barramundi, *Lates calcarifer*; common galaxias, *Galaxias maculatus*; freshwater catfish, *Tandanus tandanus*; golden perch, *Macquaria  
ambigua*; Murray cod, *Maccullochella peeli*; river blackfish, *Gadopsis marmoratus*; silver perch, *Bidyanus  
bidyanus*), population dynamics have rarely been investigated other than in the context of applications in fish passage, aquaculture and fisheries. The term ‘dynamics’ here refers to the processes that affect the size of populations over the course of time, especially recruitment, growth, mortality, migration and their interactions.

## Populations, stocks and metapopulations

The distributions of fishes within biogeographic boundaries are limited by their environmental tolerances and their abilities to compete with one another. Individual fishes rarely mate randomly with other individuals within the population’s range; there is a tendency to form discrete stocks, or subpopulations, that to some degree are genetically isolated in space, time or both. As a consequence, subpopulations often